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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/706,613

11/12/2003

James M. Daughton

N247.12-0041

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06/14/2005

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EXAMINER

HUR, JUNG H

ART UNIT

PAPER NUMBER

2824

DATE MAILED: 06/14/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/706,613

Applicant(s)

DAUGHTON ET AL.

Examiner

Jung (John) Hur

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-73 is/are pending in the application.
- 4a) Of the above claim(s) 22-73 is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 1-21 is/are rejected.
- 7) ☐ Claim(s) ____ is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 12 November 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. ____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date 4/12/04, 6/6/05.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. ____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☒ Other: search history.

DETAILED ACTION

Election/Restrictions

1. Restriction to one of the following inventions is required under 35 U.S.C. 121:
 - I. Claims 1-42 and 51-73, drawn to a memory with a heating capability, classified in class 365, subclass 225.5.
 - II. Claims 43-47, drawn to a bit structure, classified in class 365, subclass 171.
 - III. Claims 48-50, drawn to a method of storing information, classified in class 365, subclass 158.

The inventions are distinct, each from the other because of the following reasons:

Inventions I and III are related as product and process of use. The inventions can be shown to be distinct if either or both of the following can be shown: (1) the process for using the product as claimed can be practiced with another materially different product or (2) the product as claimed can be used in a materially different process of using that product (MPEP § 806.05(h)). In the instant case, the memory of Group I as claimed can be used in a materially different method of storing information than that of Group III (e.g., without the heating current through the selected bit structure or without reducing the heating current).

Inventions I and II are related as combination and subcombination, respectively.

Inventions in this relationship are distinct if it can be shown that (1) the combination as claimed does not require the particulars of the subcombination as claimed for patentability, and (2) that the subcombination has utility by itself or in other combinations (MPEP § 806.05(c)). In the instant case, the combination of Group I as claimed does not require the particulars of the subcombination as claimed, for example, an antiferromagnetic reference layer or an insulative

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layer. The subcombination of Group II has separate utility such as an information storage without heating.

Because these inventions are distinct for the reasons given above and have acquired a separate status in the art as shown by their different classification, restriction for examination purposes as indicated is proper.

Because these inventions are distinct for the reasons given above and the search required for Group III is not required for Group I or II, restriction for examination purposes as indicated is proper.

Because these inventions are distinct for the reasons given above and have acquired a separate status in the art because of their recognized divergent subject matter, restriction for examination purposes as indicated is proper.

2. This application contains claims directed to the following patentably distinct species of the claimed invention of Group I above:

- A. Claims 1-21, with a bit structure heated with a selectively connectable heat dissipation structure, the temperature approaching a critical temperature.
- B. Claims 22-42, with a bit structure heated with a pair of word line structures each having an electrical conductor, the temperature approaching a critical temperature.
- C. Claims 51-73, with a bit structure heated with a word line structure having an electrical conductor, the temperature approaching the greatest of three critical temperatures.

Applicant is required under 35 U.S.C. 121 to elect a single disclosed species for prosecution on the merits to which the claims shall be restricted if no generic claim is finally held to be allowable. Currently, no claim is generic.

Applicant is advised that a reply to this requirement must include an identification of the species that is elected consonant with this requirement, and a listing of all claims readable thereon, including any claims subsequently added. An argument that a claim is allowable or that all claims are generic is considered nonresponsive unless accompanied by an election.

Upon the allowance of a generic claim, applicant will be entitled to consideration of claims to additional species which are written in dependent form or otherwise include all the limitations of an allowed generic claim as provided by 37 CFR 1.141. If claims are added after the election, applicant must indicate which are readable upon the elected species. MPEP § 809.02(a).

Should applicant traverse on the ground that the species are not patentably distinct, applicant should submit evidence or identify such evidence now of record showing the species to be obvious variants or clearly admit on the record that this is the case. In either instance, if the examiner finds one of the inventions unpatentable over the prior art, the evidence or admission may be used in a rejection under 35 U.S.C. 103(a) of the other invention.

3. During a telephone conversation with Mr. Theodore Neils on 07 June 2005, a provisional election was made with traverse to prosecute the invention of I, Species A, claims 1-21.

Affirmation of this election must be made by applicant in replying to this Office action. Claims

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22-73 are withdrawn from further consideration by the examiner, 37 CFR 1.142(b), as being drawn to a non-elected invention.

4. Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be amended in compliance with 37 CFR 1.48(b) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. Any amendment of inventorship must be accompanied by a request under 37 CFR 1.48(b) and by the fee required under 37 CFR 1.17(i).

Information Disclosure Statement

5. Acknowledgment is made of applicant's Information Disclosure Statement (IDS) Form PTO-1449, filed 12 April 2004 and 06 June 2005. The information disclosed therein has been considered.

Specification

6. Claims 4 and 5 (and their dependent claims) are objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claim(s), or amend the claim(s) to place the claim(s) in proper dependent form, or rewrite the claim(s) in independent form.

Specifically, said claims recite "said magnetic material film is a magnetization direction maintaining film of an antiferromagnetic material" or "said magnetic material film is a magnetization direction maintaining composite film including an antiferromagnetic material".

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However, the parent claim 1 in line 6 recites “a ferromagnetic material film” which appears to be the antecedent basis for “said magnetic material film” in claim 4 and 5. Antiferromagnetic and ferromagnetic properties are different and distinct properties; thus, claims 4 and 5 fail to further limit the subject matter of claim 1.

Therefore, all references to “a ferromagnetic material film” in claim 1 will be understood as --a magnetic material film--, and in lines 7-10, “ferromagnetic property” will be understood as --magnetic property--.

Appropriate correction is required.

7. Claim 1 is objected to because of the following informalities:

Said claim in lines 18-19 recites “said first and second ferromagnetic material films” which lack antecedent bases. In conjunction with the above objection to claims 4 and 5, it will be understood as --said magnetic material film-- (singular). Appropriate correction is required.

Claim Rejections - 35 USC § 103

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

9. Claims 1-21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Leuschner (U.S. Pat. No. 6,704,220) in view of Abraham et al. (U.S. Pat. No. 6,724,674).

Regarding claim 1, Leuschner, for example in Figs. 1-5, discloses a ferromagnetic thin-film material based digital memory, said memory comprising: a plurality of bit structures (14), each supported on a substrate (10 in Fig. 3) and separated from one another by spacer material therebetween (36), and that are electrically interconnected with information retrieval circuitry (to read the stored information), said bit structures each comprising a magnetic material film (for example, 16, 24 or 26) in which its magnetic property is substantially maintained below a critical temperature (the Curie or Neel temperature of a ferromagnetic or antiferromagnetic layer, or the blocking temperature of a pinning layer) above which such magnetic property is not maintained, said bit structures each having a first interconnection structure (12) providing electrical contact thereto positioned against at least one side thereof (the bottom side); and a plurality of word line structures (22) each having a pair of word line end terminal regions (the regions of 22 overlapping 14) adapted to conduct electrical current in at least one direction therethrough (28), each of said pairs of word line end terminal regions having an electrical conductor (32) electrically connected therebetween, to cause substantial heating (via 28a) of said bit structure corresponding thereto to raise temperatures thereof to have said magnetic material film therein at least approach said critical temperature (see for example column 7, lines 6-37) while being substantially above temperatures of at least an adjacent said bit structure (for example, the adjacent bit structures that are coupled to different word lines) because of sufficient extents of, and smallness of thermal conductivities of, said first interconnection structure positioned against said corresponding bit structure and of those portions of said substrate and said spacer material positioned thereabout (since the heating current 28 flows only through a selected word line 22 for write selectivity; see also column 7, lines 57-61).

Leuschner does not disclose each said electrical conductor having a plurality of heat dissipation structures connected thereto that are each located across said spacer material from said magnetic material film in a corresponding one of said bit structures and exhibiting sufficient electrical resistance therein for a sufficient electrical current therethrough, said plurality of heat dissipating structures each having a location thereon spaced apart from where connected to a said electrical conductor that is selectively connectable so as to be capable of allowing electrical current to be established in that heat dissipating structure.

Abraham, for example in Fig. 5(a), discloses a plurality of heat dissipation structures (56) that are each located across a spacer material (between adjacent bit structures 50) from a magnetic material film (for example 51) in a corresponding one of bit structures (50) and exhibiting sufficient electrical resistance therein for a sufficient electrical current therethrough (since 56 is a heating element), said plurality of heat dissipating structures each having a location thereon spaced apart from where connected to an electrical conductor (2) that is selectively connectable (by 54) so as to be capable of allowing electrical current to be established (between 2 and 54, through 56) in that heat dissipating structure.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to modify the memory of Leuschner such that each bit structure would have a separate heat dissipating structure (a heating element) that is selectively connectable, as in Abraham, for the purpose of providing a more effective means for locally and selectively heating a selected bit structure and reducing the heating of non-selected (or half selected) bit structures coupled to a selected word line (see for example Abraham column 6, lines 43-50).

Regarding claims 2-21, the above Leuschner/Abraham combination further discloses that said selected bit structure is electrically interconnected so that an electrical current is also establishable therethrough during said heating thereof (28a in Fig. 2 of Leuschner) so as to cause its temperature to more closely approach or exceed said critical temperature of said magnetic material film therein (since the heating current 28a flows directly through the part of the bit structure that is to be heated);

that said magnetic material film is a memory film of an anisotropic ferromagnetic material (26 in Fig. 2 of Leuschner; see also, for example, column 6, lines 50-54 of Leuschner);

that said first interconnection structure extends to an adjacent one of said plurality of bit structures to make electrical contact thereto (see bit line 12 in Fig. 1 of Leuschner);

that said substrate comprises an electrical insulating layer (30 in Figs. 3-5 of Leuschner) over a monolithic integrated circuit (implied in column 1, lines 19-46 of Leuschner), and further comprises via interconnection structures each providing electrical contact to a corresponding one of said plurality of bit structures where positioned against at least one other side thereof through said insulating layer to a corresponding circuit portion in said monolithic integrated circuit (implied in column 8, lines 20-30 of Leuschner);

that said plurality of bit structures each further comprises an electrically insulative intermediate layer (18 in Fig. 2 of Leuschner) having two major surfaces on opposite sides thereof with said memory film on each of said intermediate layer major surfaces of thicknesses differing from one another outwardly from those surfaces by at least 5% (see for example 24 and 16 in Fig. 2) to thereby primarily provide switching thresholds below said critical temperature for magnetizations of said film adjacent each of said intermediate layer major surfaces that differ

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in value for a switching of these magnetizations from both being directed initially at least in part in substantially a common direction to being directed at least in part in substantially opposite directions versus a switching from being directed initially at least in part in substantially opposite directions to both being directed at least in part in substantially a common direction (implied in Fig. 2 of Leuschner which has a soft free layer structure of 20 and a hard layer structure of 16);

that a said bit structure has a length along a selected direction and a width substantially perpendicular thereto that is smaller in extent than said length and has a shaped end portion extending over a portion of said length in which said width gradually reduces to zero at an end thereof (see Fig. 9 of Leuschner);

that said magnetic material film is a magnetization direction maintaining film of an antiferromagnetic material or a magnetization direction maintaining composite film including an antiferromagnetic material (16 in Fig. 2 of Leuschner; see also, for example, column 4, lines 41-46 of Leuschner), and said bit structures further comprise a memory film of an anisotropic ferromagnetic material positioned adjacent to said magnetic material film (26 in Fig. 2 of Leuschner; see also, for example, column 6, lines 50-54 of Leuschner);

that said magnetization direction maintaining film or composite film is of an antiferromagnetic material having a blocking temperature as its critical temperature that is less than or greater than that Curie temperature characterizing said anisotropic ferromagnetic material of said adjacent memory film (implied by a list of alternative materials for 16 of Fig. 2 in column 4, lines 41-46 of Leuschner, and the range of Curie temperature for 24 and 26 of Fig. 2 in column 6, line 45 through column 7, line 6 of Leuschner);

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that said magnetization direction maintaining composite film including an antiferromagnetic material further includes two holding ferromagnetic layers separated by a ruthenium layer (implied by a list of alternative materials, including ruthenium, for 16 of Fig. 2 in column 4, lines 41-46 of Leuschner) with said antiferromagnetic material having a blocking temperature as its critical temperature that is greater than that Curie temperature characterizing said anisotropic ferromagnetic material of said adjacent memory film (implied by a list of alternative materials for 16 of Fig. 2 in column 4, lines 41-46 of Leuschner, and the range of Curie temperature for 24 and 26 of Fig. 2 in column 6, line 45 through column 7, line 6 of Leuschner);

that another said bit structure in said plurality thereof is electrically connected in series (along the word line) with said selected bit structure so that any said electrical current (28a in Fig. 2 of Leuschner) established through said selected bit structure during said heating thereof is also established through said other bit structure (see Figs. 1 and 2 of Leuschner) but is insufficient to heat that said other bit structure to substantially approach said critical temperature thereof (since, in the Leuschner/Abraham combination, the separate heating element of a selected bit structure would be used to heat only the selected bit structure to substantially approach the critical temperature), a said electrical current being establishable through said selected bit structure and a said electrical current being establishable through that said heat dissipating structure across from said selected bit structure to cause together sufficient heating of said selected bit structure to allow that magnetization of a memory film of an anisotropic ferromagnetic material provided therein to be positioned in a selected direction by at least some portion of such electrical currents in less time than that maximum data storage time period

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allowed in that digital memory in which said selected bit structure is provided (in the Leuschner/Abraham combination, the heating due to 28a in Fig. 2a would be combined with additional heating due to the selected heating element to heat only the selected bit structure to a desired temperature, while other bit structures would have no heating current or only 28a);

that said maximum data storage time period of said digital memory is less than 100 ns (see for example column 7, lines 28-37 of Leuschner).

Conclusion

10. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Nickel et al. (U.S. Pat. No. 6,603,678) discloses an MRAM with thermally-assisted switching.

Beech et al. (Journal of Applied Physics, Vol. 87, No. 9, 1 May 2000, pp. 6403-6405) discloses an MRAM with information storage in a pinned film.

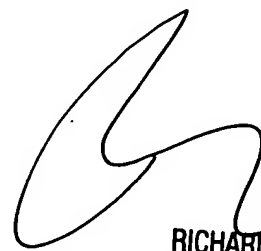
11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jung (John) Hur whose telephone number is (571) 272-1870. The examiner can normally be reached on M-F 6:30 AM - 3:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Richard Elms can be reached on (571) 272-1869. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

jhh


6/13/03
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